



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

Observations on the fern rust *Hyalopsora Polypodii*

E. T. BARTHOLOMEW

(WITH THREE TEXT FIGURES)

A study of this rust on *Cystopteris fragilis* (L.) Bernh. was undertaken in order if possible to bring together the somewhat widely varying statements of different writers with reference to its life history.

Lindau* states that *Hyalopsora Polypodii* (Pers.) Magn. has teliospores and uredinia, but no aecia, and that the uredinia have no peridia. Grove† describes teliospores and uredinia but no aecia; the uredinia, with no peridium, containing yellow, sessile spores of two kinds, respectively thick- and thin-walled, both repeatedly found in the same sorus. In his artificial infection experiments, Dietel‡ found that the first uredinia contained only thin-walled spores; later, however, thick-walled spores also were found among the thin-walled spores and in many of the uredinia formed still later, the majority of the spores were thick-walled. Arthur§ describes the two kinds of yellow spores, which for convenience he considers respectively aeciospores and urediniospores, as being in separate sori; the aecia, containing the thick-walled spores, being without a peridium, and the uredinia, containing the thin-walled spores, having only a very delicate peridium; both kinds of spores borne singly on pedicels.

The observations recorded in the present paper were obtained in two ways; by a study of fresh material both in the field and in the greenhouse, and by that of fixed and sectioned material. In both field and greenhouse considerable difference was noted between the appearances of the sori produced in cloudy weather and of those produced during a period of sunshine. Several times during the months of May and June there were periods of cloudy weather

* Kryptogamenflora für Anfänger 2. Berlin. 1912.

† The British Rust Fungi 375. Cambridge. 1913.

‡ Ueber einige Kulturversuche mit *Hyalopsora Polypodii* (Pers.) Magn. Ann. Mycol. 9: 530-533. 1911.

§ No. Am. Flora 7: 112. 1907.

lasting from three or four days to a week or more. During these periods the sori remained pale gray, but within twenty-four hours after the sun appeared they assumed a bright orange color. In contrast to this history, the sori that developed during the bright periods began to take on the yellow color even while they were quite small. Often a marked difference could also be noticed between the sori on shaded and on unshaded fronds—those on the former remaining gray for a considerable length of time, while the sori on the latter began to turn yellow almost as soon as they were noticeable.

It is not difficult to dissect an infected pinna in such a manner that large masses of the mycelium may be obtained free from the host tissues. To do this most effectively, it was found best to soak the pinnae in Flemming's weak fixing fluid for two or three

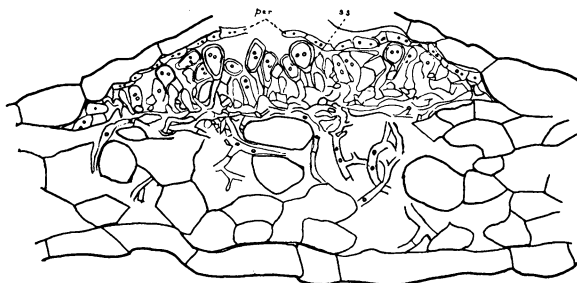


FIG. 1. Section through fixed and stained sorus, showing the peridium (*per*) and stalked spores (*ss*), \times about 390. Camera lucida drawing.

hours, then to wash them in water for about the same length of time and afterward to dehydrate them by running them through a series of progressively stronger solutions of alcohol up to 95 per cent. A sorus was then cut from a pinna and dissected under a binocular microscope. Not only could mats of the mycelium be easily obtained in this manner, but in some cases rust spores remained attached to the hyphae. Often among the separated spores one was found with its short stalk still attached. This made it plain that the spores are not sessile as stated by Grove, but that, as Arthur says, they are borne on short stalks. This observation was verified by the study of sectioned and stained preparations (FIG. 1).

In studying stained sections of a very large number of sori which had not yet broken open, not one was found without a peridium. FIG. 1 shows a typical sorus just as it is breaking open. Ordinarily, though not always, by the time the sorus has become erumpent, the peridial cells have disintegrated to such an extent that they are scarcely noticeable. In the material which was dissected with needles the peridial cells could easily be distinguished.

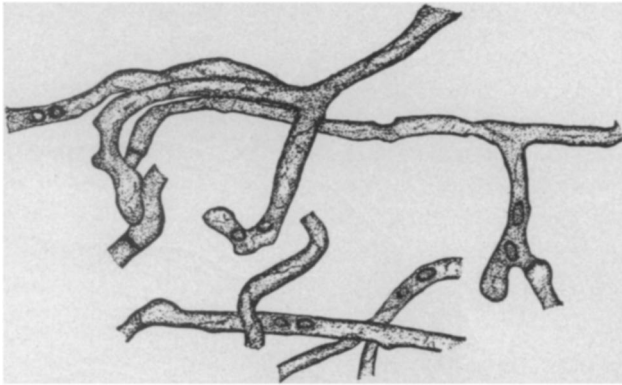


FIG. 2. Fragments of binucleate hyphae taken from the base of a sorus in which most of the spores were thick-walled, \times about 700. Camera lucida drawing.

Perhaps the most interesting part of the results of this investigation concerned the nuclear condition of the hyphae. The mats of mycelium which had been freed from the host tissues were transferred to separate slides and stained *in toto*. Without exception the cells of these hyphae were found to be binucleate. This was true of hyphae taken from the bases of sori in which the majority of the spores were thick-walled, as well as of those taken from the bases of sori containing mostly thin-walled spores. Small fragments of the mycelium are shown in FIGS. 2 and 3. Sectioned material shows the same facts as to the binucleate condition of the hyphae.

From these observations it would seem that there can no longer be any basis for calling the thick-walled spores aeciospores and the thin-walled spores urediniospores. This conclusion would indicate that there must be an aecial host for this rust, and although Bubak* has been unsuccessful in his attempts to inoculate species

* Infektionsversuche mit einigen Uredineen. *Centralb. Bakt. Zweite Abt.* 12: 411-426. 1904; 16: 150-159. 1906.

of *Abies* and *Pinus* with *Hyalopsora*, future workers will probably find the aecial host of *Hyalopsora* as has been done for different species of *Uredinopsis*.

An explanation for the production of two kinds of urediniospores at the present time may be at least suggested.* Of the

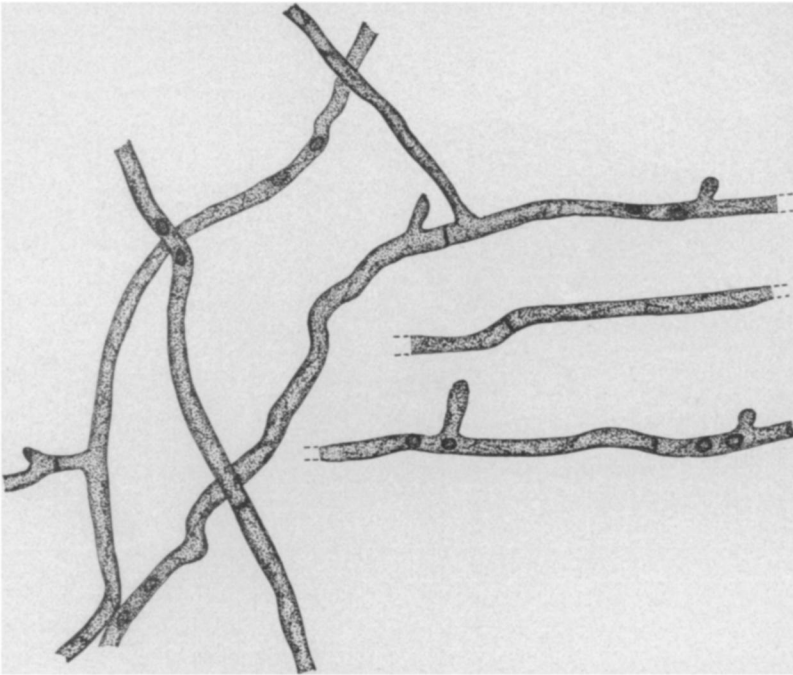


FIG. 3. Fragments of binucleate hyphae taken from the base of a sorus in which most of the spores were thin-walled, \times about 680. Camera lucida drawing.

groups of plants which now serve as hosts to the various rusts, the pteridophytes are the oldest. This gives some ground for assuming that the fern rusts are the most ancient of the rusts now living. Following the pteridophytes came the gymnosperms, and it is upon the conifers of this group that, as far as is now known, the aecial stage of the fern rusts appears. We may suppose, then, that some of the conifers became susceptible to infection by one stage of the rusts already parasitic upon the pteridophytes. It follows that one of the present spore forms of the fern rusts is a

* This suggestion was first made to the writer by Dr. J. J. Davis of this laboratory.

relic of an autoecious condition which prevailed in connection with a uninucleate mycelium that developed from a sporidial infection. As a result of the passing of the aecial stage to the conifers, only binucleate mycelial stages are now found in the ferns. From the persistence of the primitive spore form under the changed conditions, one may infer that the autoecious condition in the history of these rusts existed for a long period of time. While not germane to the question as to the spore forms of the fern rusts, it may not be amiss to carry the speculation a little further with the suggestion that the angiosperms upon their appearance became infected by aeciospores from conifers, and that consequently the most primitive rusts of phanerogams bear their aecia upon coniferous hosts.

UNIVERSITY OF WISCONSIN,
MADISON, WISCONSIN